AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1. (currently amended) An organic contaminant molecule sensor for use in a ~~low oxygen concentration monitored~~ process environment having a low oxygen concentration~~, the sensor~~ comprising:

an electrochemical cell comprising:

a solid state oxygen anion conductor in which oxygen anion conduction occurs at or above a critical temperature~~ T_e,~~;

a measurement electrode formed on a first surface of the anion conductor for exposure to the monitored environment, the measurement electrode comprising a material for ~~catalysing~~ catalyzing the ~~dissociative adsorption~~dehydrogenation of ~~the~~ an organic contaminant molecule wherein at temperatures below the critical temperature, organic contaminant molecules are adsorbed onto and dehydrogenated at the surface of the material of the measurement electrode to form a carbonaceous deposit on the surface of the material of the measurement electrode~~,~~; and

a reference electrode formed on a second surface of the anion conductor for exposure to a reference environment, the reference electrode comprising a material for ~~catalysing~~ catalyzing the dissociation of oxygen to oxygen anions; ~~means~~

a heater for controlling ~~and monitoring~~ the temperature of the electrochemical cell; and

a current source ~~means~~ for controlling the electrical current ~~flowing~~ between the reference electrode and the measurement electrodes~~,~~ wherein ~~whereby at temperatures below T_e, organic contaminant molecules are adsorbed onto and dissociated at the surface of the measurement electrode leading to the build up of carbonaceous deposits at the surface thereof, and~~ at temperatures above ~~T_e~~the critical temperature, an electrical current is passed between the reference electrode and the measurement electrode ~~thereby~~ to control the number of oxygen anions passing from the reference electrode to the measurement electrode to ~~oxidise~~ oxidize the carbonaceous deposits~~ formed at the surface thereof and the formation of carbon dioxide~~.

2. (currently amended) The ~~A~~ sensor according to Claim 1~~,~~ wherein the measurement electrode ~~is coated with or formed from material~~ comprises a metal selected from the group ~~comprising~~ of metals consisting of rhenium, osmium, iridium, ruthenium, rhodium, platinum and palladium and alloys thereof.

3. (currently amended) The~~A~~ sensor according to Claim 2~~,~~ wherein the alloys include ~~one or more~~ an element~~s~~ selected from the group of elements consisting of silver, gold and copper.

4. (cancelled)

5. (currently amended) The~~A~~ sensor according to Claim ~~4~~3~~,~~ wherein the reference electrode ~~is formed from platinum, palladium or other~~comprises a metal capable ~~to~~of ~~dissociatively adsorb~~dissociating oxygen~~ or any alloy thereof~~.

6. (currently amended) The~~A~~ sensor according to ~~any preceding c~~Claim 1~~,~~ wherein the solid state oxygen anion conductor is selected from the group of conductors consisting of gadolinium doped ceria and yttria ~~stabilised~~ stabilized zirconia.

7. (currently amended) The~~A~~ sensor according to ~~any preceding c~~Claim 1~~,~~ comprising a counter electrode positioned adjacent to the reference electrode.

8. (currently amended) The~~A~~ sensor according to Claim 7~~,~~ wherein the counter electrode ~~is formed from platinum, palladium or other~~ comprises a metal capable ~~to~~ of ~~dissociatively~~ dissociating ~~adsorb~~ oxygen.

9. (currently amended) The~~A~~ sensor according to ~~any preceding c~~Claim 1~~,~~ comprising a reference environment ~~wherein the reference environment is~~having a gaseous source of oxygen at atmospheric pressure~~, preferably atmospheric air~~.

10. (currently amended) The~~A~~ sensor according to ~~any of~~ Claim~~s~~ 1 ~~to 8,~~ wherein the reference environment comprises a solid-_state source of oxygen.

11. (currently amended) The~~A~~ sensor according to Claim 10~~,~~ wherein the solid state source of oxygen ~~is selected from~~comprises a metal/metal oxide compound. ~~couple (optionally Cu/Cu2O or Pd/PdO), or a metal oxide/metal oxide couple (optionally Cru20 CuO).~~

12. (currently amended) The~~A~~ sensor according to ~~any preceding c~~Claim 1~~,~~ wherein the heater further includes a thermocouple assembly ~~the means for controlling or monitoring the temperature of the cell comprises a heater and thermocouple arrangement~~.

13. (currently amended) The~~A~~ sensor according ~~to any preceding c~~Claim 1~~,~~ further including means for ~~providing~~ measuring a potential across the sensor.

14. (currently amended) ~~Use of a~~The sensor according to ~~any preceding claim~~ Claim 13 wherein the sensor ~~for~~ monitors~~ing~~ the levels of trace organic contaminants in a low oxygen concentration monitored process environment.

15. (currently amended) A method of monitoring the levels of trace organic contaminants in a ~~monitored~~ process environment~~, the method~~ comprising the steps of:

providing an electrochemical sensor comprising a solid state oxygen anion conductor in which oxygen anion conduction occurs at or above a critical temperature ~~T_e~~, a measurement electrode formed on a first surface of the conductor for exposure to the ~~monitored~~ process environment, the measurement electrode comprising a material for ~~catalysing~~ catalyzing the ~~dissociative adsorption~~ dehydrogenation of the trace organic contaminants ~~molecule~~, and a reference electrode formed on a second surface of the conductor for exposure to a reference environment, the reference electrode comprising a material for ~~catalysing~~ catalyzing the dissociation of oxygen to oxygen anions;

exposing the measurement electrode at a sensor temperature T_{ads} to the ~~monitored~~ process environment for a time t_{ads} to cause one or more of the trace organic contaminants ~~species~~ to ~~be~~ adsorb~~ed~~ onto and dehydrogenate at the surface of the measurement electrode thereby leading to ~~the~~ build up of a carbonaceous deposit at the surface ~~thereof~~ of the measurement electrode;

raising the temperature of the electrochemical sensor to a value T_{tit} above the critical temperature ~~T_e~~ of the solid state oxygen anion conductor and passing a current I_p between the

reference electrode and the measurement electrode for a time t_p ~~taken~~ sufficient for the potential difference across the electrochemical sensor to reach a constant value determined by the equilibrium between the flux of oxygen anions arriving at the measurement electrode ~~surface~~ and the rate of desorption of oxygen gas from the reference electrode ~~surface~~; and

determining, from ~~the~~ a total charge ($I_p t_p$) passed through the electrochemical sensor at temperature T_{tit}, the amount of carbonaceous deposits present at the surface of the measurement electrode and therefore the concentration of trace organic contaminants ~~species present~~ in the process environment.

16. (currently amended) The~~A~~ method according to Claim 15~~, wherein,~~ further comprising ~~subsequent to the adsorption step, the sensor is heated~~ the step of raising the temperature of the electrochemical sensor to a temperature ~~intermediate~~ between T_{ads} and T_{tit} prior to the step of raising the temperature of the electrochemical sensor to T_{tit}. ~~to facilitate the complete conversion of any uncracked hydrocarbon contaminant to a carbonaceous deposit on the surface of the measurement electrode, and thereafter the temperature of the sensor is raised to T_{tit}.~~

17. (currently amended) The~~A~~ method according to Claim 15 ~~or Claim 16,~~ wherein T_{ads} is ~~in the range~~ from 20 to 150°C.

18. (currently amended) The~~A~~ method according to ~~any of~~ Claims 15 ~~to 17,~~ wherein t_{ads} is ~~in the range~~ from 102 to 105 seconds.

19. (currently amended) The~~A~~ method according to Claim 18~~,~~ wherein t_{ads} is ~~of the order of~~ about 104 seconds.

20. (currently amended) The~~A~~ method according to ~~any of~~ Claims 15 ~~to 19,~~ wherein T_{tit} ~~is in the range~~ from 300 to 600°C.

21. (currently amended) The~~A~~ method according to ~~any of~~ Claims 15 ~~to 20,~~ wherein I_p is ~~in the range~~ from 10nA to 100uA.

22. (currently amended) The~~A~~ method according to ~~any of~~ Claims 15 ~~to 21,~~ wherein the electrochemical sensor ~~is provided with~~comprises a counter electrode positioned adjacent to the reference electrode.

23. (currently amended) The~~A~~ method according to ~~any of~~ Claims 15 ~~to 22,~~ wherein the reference environment ~~is~~ comprises a ~~gaseous~~ source of oxygen at atmospheric pressure~~, preferably atmospheric air~~.

24. (currently amended) The~~A~~ method according to ~~any of~~ Claims 15 ~~to 22,~~ wherein the reference environment comprises a solid-state source of oxygen.

25. (currently amended) The ~~A~~ method according to Claim 24 wherein the solid state source of oxygen ~~is~~comprises ~~selected from~~ a metal/metal oxide ~~couple~~ compound ~~(optionally Cu/Cu$_2$0 or Pd/PdO),~~ or a metal oxide/metal oxide ~~couple (optionally Cu$_2$O/ CuO)~~compound.

26. (currently amended) The~~A~~ method according to ~~any of~~ Claims 15 ~~to 25, wherein a~~comprising the step of applying a potential V_i ~~is applied~~ across the electrochemical sensor.

27. (new) The sensor according Claim 12 further including a device for measuring a potential across the sensor.

28. (new) The sensor according to Claim 27 wherein the sensor monitors the levels of trace organic contaminants in a low oxygen concentration monitored process environment.

29. (new) The sensor according to Claim 12 wherein the measurement electrode comprises a metal selected from the group of metals consisting of rhenium, osmium, iridium, ruthenium, rhodium, platinum and palladium and alloys thereof.

30. (new) The sensor according to Claim 29 wherein the alloys include an element selected from the group of elements consisting of silver, gold and copper.

31. (new) The sensor according to Claim 7 wherein the heater further includes a thermocouple assembly.

32. (new) The sensor according Claim 31 further including means for measuring a potential across the sensor.

33. (new) The sensor according to Claim 32 wherein the sensor monitors the levels of trace organic contaminants in a low oxygen concentration monitored process environment.

34. (new) The sensor according to Claim 33 wherein the reference electrode comprises platinum, palladium or other metal capable of dissociating oxygen.

35. (new) The sensor according to Claim 7 wherein the measurement electrode comprises a metal selected from the group of metals consisting of rhenium, osmium, iridium, ruthenium, rhodium, platinum and palladium and alloys thereof.

36. (new) The sensor according to Claim 35 wherein the alloys include an element selected from the group of elements consisting of silver, gold and copper.

37. (new) The sensor according to Claim 13 wherein the measurement electrode comprises a metal selected from the group of metals consisting of rhenium, osmium, iridium, ruthenium, rhodium, platinum and palladium and alloys thereof.

38. (new) The sensor according to Claim 37 wherein the alloys include an element selected from the group of elements consisting of silver, gold and copper.

39. (new) The sensor according to Claim 38 wherein the reference electrode comprises a catalyst for the dissociation of oxygen.

40. (new) The sensor according to Claim 39 wherein the reference electrode comprises a metal capable of dissociating oxygen.

41. (new) The sensor according to Claim 13 wherein the solid state oxygen anion conductor is selected from the group of conductors consisting of gadolinium doped ceria and yttria stabilized zirconia.

42. (new) The sensor according to Claim 13 comprising a reference environment having a gaseous source of oxygen at atmospheric pressure.

43. (new) The sensor according to Claim 13 wherein the reference environment comprises a solid state source of oxygen.

44. (new) The sensor according to Claim 43 wherein the solid state source of oxygen comprises a metal/metal oxide compound.

45. (new) The sensor according to Claim 5 wherein the metal capable of dissociating oxygen is selected from the group of metals consisting of platinum and palladium.

46. (new) The sensor according to Claim 8 wherein the metal capable of dissociating oxygen is selected from the group of metals consisting of platinum and palladium.

47. (new) A sensor according to Claim 10 wherein the solid state source comprises a metal oxide/metal oxide compound.

48. (new) The sensor according to Claim 40 wherein the metal capable of dissociating oxygen is selected from the group of metals consisting of palladium and platinum.

49. (new) The sensor according to Claim 43 wherein the solid state source of oxygen comprises a metal oxide/metal oxide compound.